INL has developed a new technology that can pull radioactive contamination off building surfaces more effectively than previous methods, minimizing cost, waste volume and worker exposure.

Gelatin helps foam pull radioactive contaminants from building structures

By Nicole Stricker, *INL Communications & Governmental Affairs*

Researchers looking for a new fix to a stubborn problem have found a solution in good old-fashioned gelatin. The stuff of colorful childhood treats provides the rigidity required for a new type of foam that can stick fast to walls or ceilings.

So why would anyone care about a rigid, gelatin-laced foam? Because the technology can leach radioactive particles or toxic metals from contaminated surfaces more quickly and cheaply than traditional methods.

Radioactive contamination can be difficult to remediate. Removing contamination from complex surfaces such as brick or concrete can be costly, inefficient and hazardous. But the new approach developed at Idaho National Laboratory is changing that.

The INL development team is comprised of, left to right, Julia Tripp, Karen Wright, Laurence Hull, Dean Peterman, Craig Cooper and Rick Demmer.

The foam can be used alone or in conjunction with a specialized clay to pull contamination off surfaces more effectively than previous methods. The new approach minimizes cost, waste volume and worker exposure. It has been commercially licensed by Environmental Alternatives, Inc. (EAI), as Rad-Release Chemical Decontamination Technology, or simply Rad-Release.

"This technology has proven itself in several comparison tests and real-world cleanup sites," said Rick Demmer, an INL chemist and co-inventor of the technology. "When we used the technology in September to decontaminate a manipulator at INL, it reduced employee exposures, time spent and waste generated compared to the traditional method."

The Problem

Although manipulator contamination is part of routine nuclear research at national labs such as INL, many cleanup projects are far more daunting. There are federal, state, private, and mining sites throughout the U.S. that may be contaminated with radiation and toxic metal, and these sites may also contain building structures requiring cleanup, which carries considerable cost.

That's partly because radioactivity can be extremely difficult to remove from building surfaces. Radioactive particles can stick strongly to such surfaces or come to rest in hard-to-reach pores and crevices. So for the past 50 years, contaminated materials or structures had to be dismantled and simply buried or isolated in storage. Such methods can be expensive, require significant volumes of storage space and present risks to workers.

Other decontamination approaches are labor intensive, ineffective at removing embedded sub-surface contamination and generate larger volumes of waste. Other agents also can be difficult to use effectively on walls or ceilings since they do not contain a robust foam element.

The Solution

So the INL team set out to make a decontamination agent that was rigid enough to stick to vertical or inverted surfaces for several hours. Strong acids within the agent dissolve oxide layers while other chemicals act like magnets for radioactivity. To put these properties into a foam, team member Demmer tried a variety of substances before discovering that gelatin had the right properties.

"Initially we found that when we drove the pH down, it compromised the foam pretty substantially," said Demmer. "I tried all manner of foam stabilizers, including egg protein and standard chemicals you'd find in soap."

After borrowing some cherry-flavored gelatin from an INL cafeteria, Demmer discovered that gelatin bestowed the rigidity they'd been striving for. As the foam clings to a contaminated surface, it attracts radioactive particles and traps them within. After 20 minutes to 1 hour, the foam is rinsed and/or vacuumed off the surface for disposal.

The process takes just a few hours, reduces surface contaminants by up to 90 percent and produces a compact waste form. When faced with very porous surfaces with deeply embedded sub-surface contamination, a second step can be added utilizing a special clay material to penetrate pores and crevices, pull contaminants from the subsurface over several days or weeks, and reduce contamination by as much as 99 percent.

"You need a wet pathway and if you create this sort of sponge action, you'll draw the contamination back to the surface," said INL geochemist and co-inventor Karen Wright. "It was absolutely an 'Aha!' moment."

A special clay material can be used to penetrate pores and crevices of very porous surfaces with deeply embedded sub-surface contamination.

The clay shrinks by 80 percent after it is removed from the surface and allowed to dry, drastically reducing the final waste volume.

The process is applicable for a variety of radionuclides and toxic metals. It is adaptable to many types of surfaces including walls, ceilings, beams and irregular surfaces found on tools and equipment. And it can be used on a myriad of materials including concrete, cinder block, granite, brick, tile, asphalt, wood, marble, glass and steel.

Evidence it Works

So far, Rad-Release has proven itself in real-world national laboratory settings, in a side-by-side test sponsored by the EPA, and in both domestic and international competitions. It even wowed radiation technicians right here at its birthplace.

In September, an INL hot cell manipulator needed to be decontaminated before it could be repaired. Initial attempts using traditional methods took roughly 20 hours, generated about 20 gallons of waste, and left a large amount of radioactivity. Such a highly contaminated manipulator might be impossible to repair without exposing employees to high radiation levels, forcing possible replacement of a $40,000 tool.

Then the repair team heard about the Rad-Release technology developed by INL colleagues. They gave it a try. In about 2 hours, the Rad-Release chemistry removed so much radioactive contamination that the manipulator's dose rates fell about a hundredfold. The technique generated less than 2 gallons of waste.

The Rad-Release foam is removed from surfaces for disposal, reducing surface contaminants by up to 90 percent and producing a compact waste form.

"If fully implemented, this approach could easily be expected to significantly reduce worker exposure, decontamination and repair costs," said Ron Johansen, an INL mechanical engineer involved with the manipulator project.

A similar application at Argonne National Laboratory last year was equally efficient and successful — removing 94 percent of contamination in a single 90-minute application. In fact, a side-by-side performance comparison of different decontamination approaches revealed that the two-step Rad-Release technology was one of the most effective processes.

It also impressed attendees at two decontamination exercises involving diverse technologies — the EPA's Liberty RadEx demonstration and an international competition at the Canadian Forces Base in Suffield, Alberta. In the Canadian field demonstration — coined "Little House on the Prairie" because it involved decontaminating a test house's vinyl, glass and brick exteriors — Rad-Release was the most effective of three technologies demonstrated.

What's Next

Despite its successes, the technology does have limitations, which licensee EAI is addressing. For example, development work is being conducted to improve methods for the removal of the foam and the collection and treatment of the secondary waste. EAI is also working on ways to adjust the formulas to reduce their corrosiveness on delicate surfaces and on ways to adjust the reagents to tailor the process for special applications.

Nevertheless, R&D Magazine selected Rad-Release for an R&D 100 Award, deeming the technology one of the most significant inventions to enter the marketplace in 2011. This sort of recognition illustrates how publically funded research can feed commercial innovation while solving both national and international challenges.

"The Rad-Release technology coupled with the technical support of the INL Team is revolutionizing the way that future decontamination and site clean-up will be accomplished," the EAI Team has stated.

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